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UNMANAGED DRINKING WATER SOURCES IN ARID AREAS OF RAJASTHAN : A CASE STUDY OF NAGAUR DISTRICT

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ABSTRACT

The study on the quality of drinking water in Nagaur district revealed several types of water-borne diseases viz., stomach disorder, deformation of bones, guineaworm infestation and other infectious diseases especially in the villages using tank water. Deformation of bones and stomach disorders were more common in the villages mostly dependent on groundwater. The ground water was also found to have high total soluble salts, sulphate, nitrate, chloride and fluoride contents. It emerges from this case study that a major percentage of the inhabitants do not receive potable and safe drinking water. Hence, some measures to overcome these health problems associated with drinking water sources have been suggested.

INTRODUCTION

Western Rajasthan is a chronically water scarcity area where drinking water is often a precious commodity. Many villages have to depend on groundwater resources, viz. wells, tube wells and *beri* to meet the drinking water requirement. But 65% of the area has ground water with more than 3200 ppm total soluble salts. The age-old practice of harnessing the meagre surface runoff in village tanks or waterholes (*nadi*) is still followed. The water from the *nadi* is used for two months to whole of the year depending on the capacity of the individual *nadi*. Similarly, the meagre runoff either from the field or from the house top is collected in underground reservoir i.e. *tanka*.

Although these drinking water sources have been in use for the past several centuries, these are not free from health hazards due to their poor maintenance and improper utilization. A case study on this problem pertaining to Nagaur district has been presented in this paper. The district, covering an area of 17464.51 sq. km has 1216 populated and 35 unpopulated villages. The total human and livestock population of the district are 12,62,157 and 23,04,208 (1971 Census), respectively.

MATERIAL AND METHODS

The study was undertaken in 1976-77. Groundwater samples were collected from November to March when the salinity level in groundwater is expected to be the highest. The water samples were analysed by standard methods. Secondary statistics was collected on the basis of

the villagers response to various items in a questionnaire from almost every village and from the District Census Hand Book, 1971. Occurrences of various diseases were recorded for each village.

RESULTS

SURFACE WATER RESOURCES

Village tanks (nadi) : There are 1245 tanks in the entire district. Nearly 29 per cent of the villages do not have any tank and generally depend on ground water. Use of the catchment areas of the *nadi* for the purpose of defecation, etc. by the villagers is not allowed. However, movement of the livestock there causes pollution and increase in salt content of the water. The *nadi* water is not used for drinking but local people take bath, clean their utensils and take their livestock for drinking and bathing there. Such usage leads to pollution of water and growth of guinea worms, water hyacinth, mosses and algae etc. Although water sample was not analysed for nitrates, studies conducted by Ghosh *et al.* (1984) indicated presence of high quantity of nitrogen in such water.

Underground resrvoirs (tanka) : Generally *tankas* are owned by individual families and as such no detailed information could be collected on these. However, water collected during an average rainfall year is adequate for drinking for one year by a family of 4 to 6 persons. It has, however, been observed that water collected in *tanka* is generally turbid, and may, sometimes, contain germs.

GROUND WATER

There are 15,662 wells and tube wells in the entire district. Out of this 52.15 per cent are generally in use every year. Nearly 32.52 per cent villages do not have wells and are generally dependent on tank or *tanka* water. Most of the wells are being used as a source of drinking water. Generally, these wells are not properly covered and as a result, inhygienic materials dumped by the villagers in the adjoining areas enter the wells through dust storms and rains.

QUALITY OF GROUNDWATER

TOTAL SOLUBLE SALTS

The world Health Organization (WHO) has stipulated a permissible limit of 500 ppm and an excessive limit of 1500 ppm (TSS) in drinking water. The Indian Council of Medical Research (ICMR) has also adopted the same standards. However, water containing upto 4000 ppm TSS are reported to be used for drinking in many arid and semi-arid regions where better quality of water is not easily available. No harmful physiological effects of permanent nature have, however, been noticed. Out of 1042 ground water samples analysed form the study area, 0.67, 3.46, 24.38, 32.63 and 40.86 per cent of the samples have less than 180, 180 to 500, 500 to 1500, 1500 to 3200, and over 3200 ppm TSS, respectively.

Water with TSS less than 3200 ppm has been found in 79.12, 47.45, 66.86, 26.36, 65.65, 44.94, 56.44 and 70.07 per cent of the samples from Merta,

Didwana, Nagaur, Ladnu, Parbatsar, Nawa, Jayal and Degana tehsils, respectively. In Nagaur district 26.13, 41.11 and 32.76 per cent of the area has water with TSS content upto 1500, 1500 to 3200 and over 3200 ppm, respectively.

CHLORIDES

The WHO suggested an acceptable limit of 200 ppm and a maximum permissible limit of 600 ppm. However, the ICMR, while accepting the lower limit of 200 ppm has raised the upper limit to 1000 ppm. Of the water samples analysed 25.51, 28.02, 8.42 and 40.04 per cent have chloride content of less than 200, 200 to 600, 600 to 800 and more than 800 ppm, respectively. Nearly, 28.59, 47.27, 42.62 47.82, 38.27, 25.85, 66.38 and 26.53 per cent of the samples from Merta, Didwana, Nagaur, Ladnu, Parbatsar, Nawa, Jayal and Degana tehsils, respectively have chloride contents of over 800 ppm.

SULPHATES

Sulphates are commonly present in ground water and are not considered harmful when present in limited concentrations. The WHO has suggested an acceptable concentration of 200 ppm and 400 ppm as allowable concentration. The ICMR has also adopted this classification. In some countries the upper limit has been raised to 600 ppm.

Of the samples analysed 63.61, 25.34, 5.36 and 5.69 per cent have sulphate concentration of less than 200, 200 to 400, 400 to 600 and over 600 ppm, respectively.

12.08, 12.42, 22.99, 10.11, 13.86, 18.34 per cent of the water samples from Merta, Nagaur, Ladnu, Parbatsar, Nawa, Jayal and Degana tehsils, respectively have sulphate contents of over 400 ppm.

FLUORIDES

The ICMR has stipulated 1 ppm as the highest desirable level and 1.5 ppm as the maximum permissible level of fluorides in drinking water.

Of the water samples 27.71, 14.02, 30.81 and 27.46 percent have fluoride content of less than 1, 1 to 1.5, 1.5 to 2 and over 2 ppm, respectively. Nearly 76.92, 74.10, 36.56, 74.25, 51.52, 71.14, 18.0 per cent of the samples of Ladnu, Didwana, Jayal, Nagaur, Merta, Nawa, Degana and Parbatsar tehsils, respectively have fluoride concentration of over 1.5 ppm. There are many zones in isolated pockets in the district e.g. north-west part of Makrana in Parbatsar tehsil where the fluoride concentration of underground water in high.

In general, all villagers partly use *nadi* water and partly well water for drinking purposes. The dependency on and duration of availability of well and *nadi* water for Nagaur district have been shown in Fig. 1.

WATER BORNE DISEASES

Usually four type of water-borne diseases, viz. stomach disorders, deformation of bones, guinea worms infestation and other infectious diseases have been reported from many of the villages (Fig. 2). Diseases of the stomach, infectious

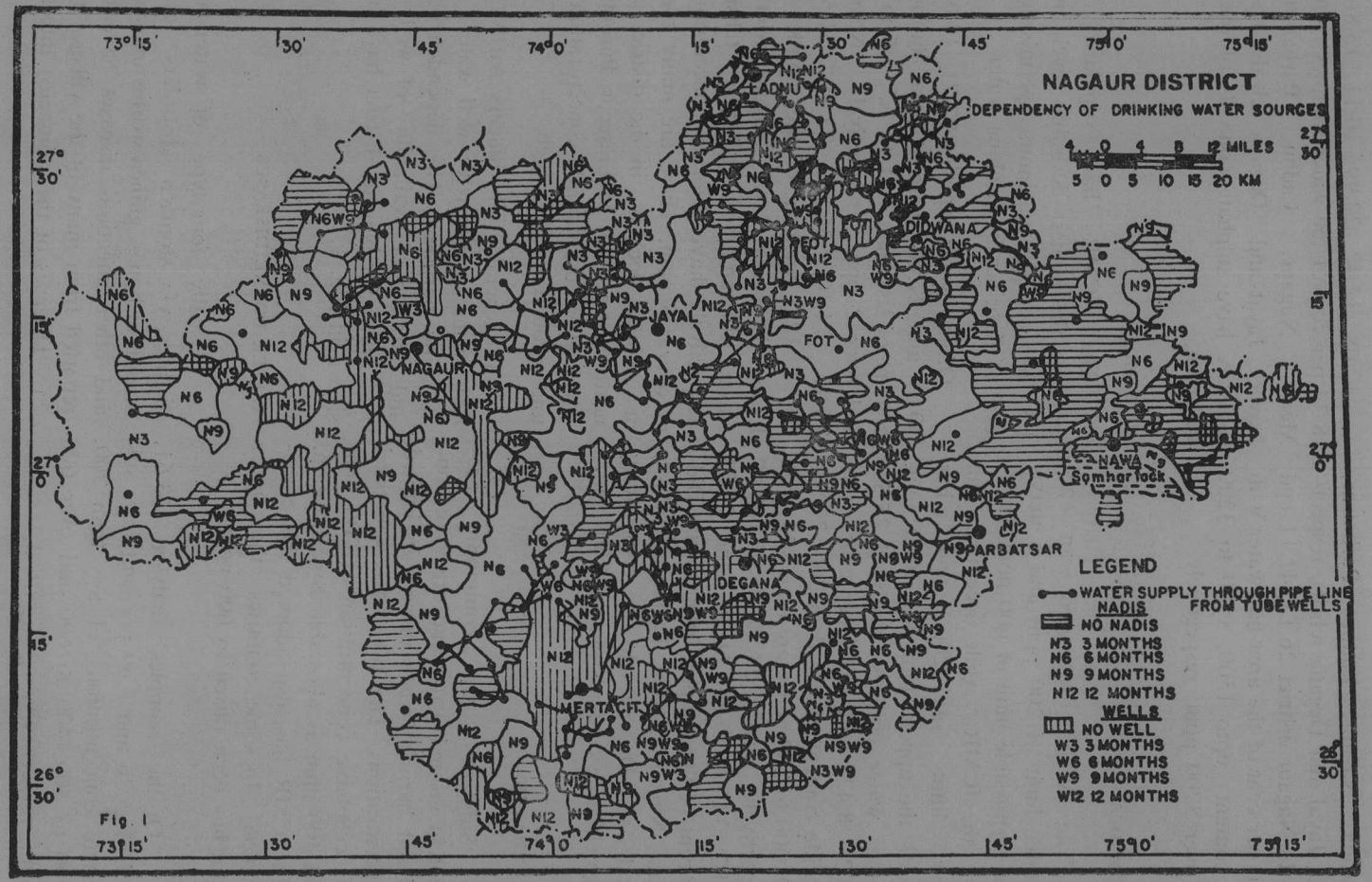
NAGAUR DISTRICT
DEPENDENCY OF DRINKING WATER SOURCES
4 0 4 8 12 MILES
5 0 5 10 15 20 KM
LADNU
DIDWANA
JAYAL
NAGAUR
FOT
NAWA
Sambhar lake
PARBATSAR
DEGANA
MERTA CITY
LEGEND
WATER SUPPLY THROUGH PIPE LINE FROM TUBE WELLS
NADIS
NO NADIS
N3 3 MONTHS
N6 6 MONTHS
N9 9 MONTHS
N12 12 MONTHS
WELLS
NO WELL
W3 3 MONTHS
W6 6 MONTHS
W9 9 MONTHS
W12 12 MONTHS
Fig. 1

Fig. 1.

diseases and guineaworms infestation are associated more with the villages where *nadi* water has long been in use. The inhabitants of the villages which are more dependent on groundwater mostly suffer from deformation of bones and stomach diseases. The stomach diseases are usually associated with the villages where sulphate and nitrate contents are high in the ground water.

DISCUSSION

An appraisel of the data presented in Table 1 indicates that 30.92 per cent of the villages of Nagaur district have no disease infection associated with drinking water sources. The maximum number of villages in this category are in Degana tehsil followed by Nagaur, Didwana, Nawa, Ladnu, Merta and Jayal tehsils. Only one type of disease has been observed in 32.06 percent of the villages, the maximum number of such villages being situated in Nawa, Parbatsar, and Nagaur tehsils, ranging from 5.87 to 6.50 per cent of the villages, followed by Degana, Merta, Didwana, Jayal and Ladnu tehsils. The highest number of villages recording two types of diseases occur in Parbatsar tehsil (7.41 per cent) and the lowest in Nawa tehsil (0.09 percent). In the rest six tehsils, viz., Nagaur, Jayal, Didwana, Merta, Degana and Ladnu, 6.32, 5.15, 3.97, 2.80, 1.54 and 1.63 per cent of the villages, respectively have two types of water-borne diseases. Three types of diseases were mostly observed in Parbatsar tehsil (1.54 per cent of the villages), followed by Didwana, Nagaur, Jayal and Merta tehsils. In Ladnu, Nawa and Degana tehsils, none of the villages had three types of diseases. Similarly, in Ladnu, Nawa, Degana and Merta tehsils, none of the villages had four types of diseases which were observed mostly in Nagaur tehsil (1.08 per cent of the villages), followed by Parbatsar, Jayal and Didwana tehsils.

Table 2 depicts the distribution of the types of water-borne diseases. It indicates that 38.42 percent of the villages in the district suffer from guinea worms infestation and 31.95 percent from infectious diseases. This is due to their habit of drinking *nadi* water. Inhabitants of 20.35 percent of villages suffer from deformation of bones and dental decay due to high fluoride content of the groundwater and 9.28 percent with stomach diseases, principally due to drinking of *nadi* water and partly due to the groundwater containing high amount of sulphates, nitrates and chlorides.

The maximum number of villages afflicted with infectious diseases and guineaworms belong to Nagaur, Jayal, Didwana, Parbatsar and Merta tehsils while bone deformation and guinea worms infestation occur mostly in the villages of Nawa and Degana tehsil. In the Ladnu tehsil guinea worms infestation is the major health hazard, while deformation of bones and infectious diseases claim almost similar number of victims from among the rest of the population However, none of the villages of Ladnu. Nawa and Merta tehsils reported any case of stomach diseases.

CONCLUSION

Although the Indian Council of Medical Research has stipulated a maximum permissible limit of 1.5 ppm fluoride in groundwater meant for human con-

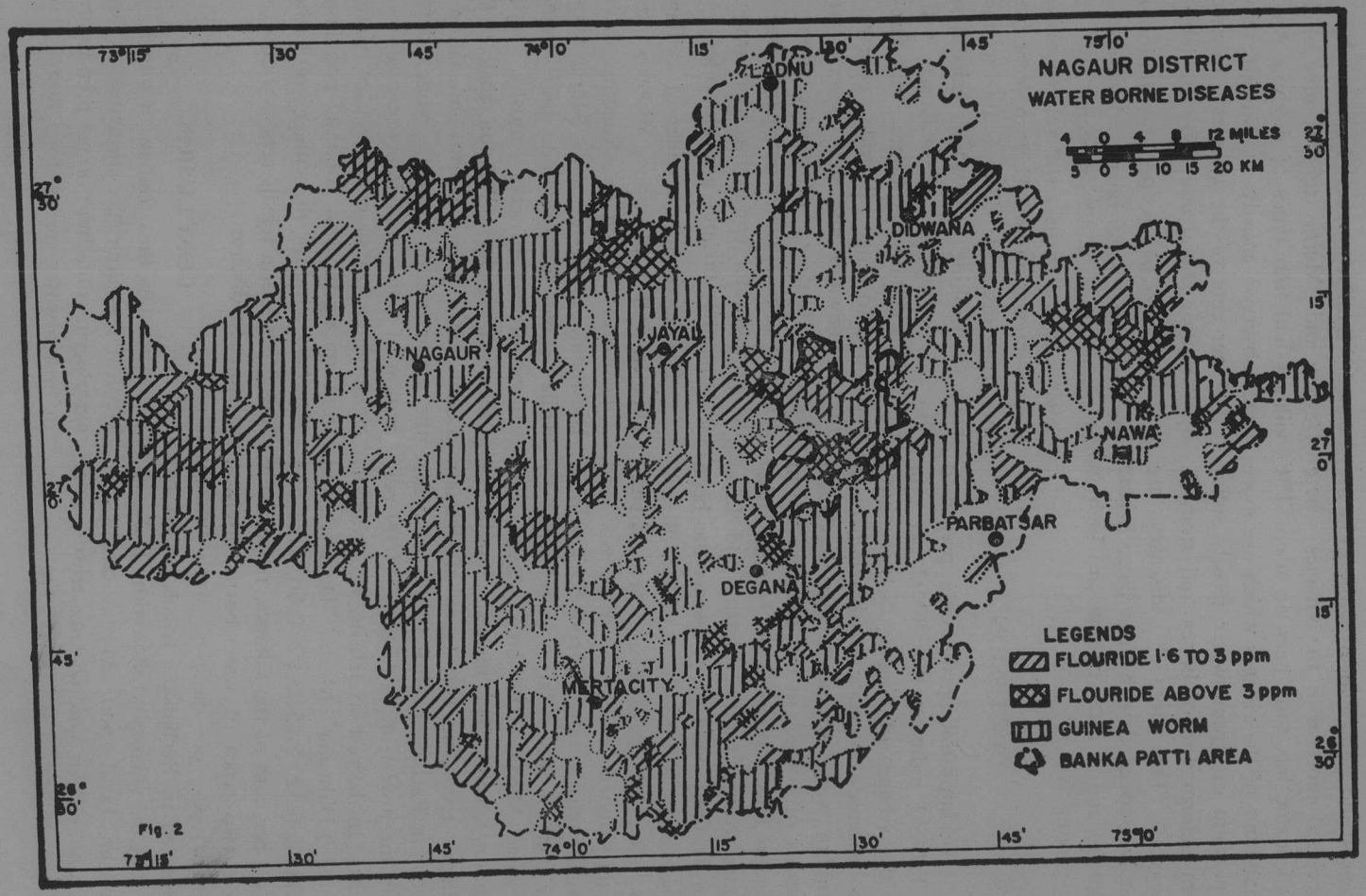
NAGAUR DISTRICT
WATER BORNE DISEASES
4 0 4 8 12 MILES
5 0 5 10 15 20 KM
LADNU
DIDWANA
NAGAUR
JAYAL
NAWA
PARBATSAR
DEGANA
MERTACITY
LEGENDS
FLOURIDE 1·6 TO 3 ppm
FLOURIDE ABOVE 3 ppm
GUINEA WORM
BANKA PATTI AREA
Fig. 2

Fig. 2

Table 1. Number of diseases in a village, based on 1107 sampled villages

Occurrence of diseases	Nagaur	Jayal	Ladnu	Didwana	Nawa	Parbatsar	Degana	Merta	Total
No disease	16.38	7.89	10.23	14.62	13.16	6.43	22.52	8.77	100%
	25.92	23.08	47.95	35.21	38.14	11.06	53.10	30.93	(30.9%)
	(5.06)	(24.44)	(3.16)	(4.53)	(4.06)	(1.99)	(6.96)	(2.72)	
One type of	18.31	4.23	5.63	7.89	20.28	19.44	14.37	9.85	100%
disease	30.09	12.82	27.40	19.72	61.01	34.67	35.17	36.08	(32.06%)
	(5.87)	(1.35)	(1.81)	(2.53)	(6.50)	(6.23)	(4.61)		
Two types of	21.88	17.81	5.63	13.75	0.31	25.63	5.31	9.68	100%
diseases	32.41	48.65	24.65	30.98	0.85	41.21	11.73	31.96	(28.91%)
	(6.32)	(5.15)	(1.63)	(0.09)	(7.41)	(7.41)	(1.54)	(2.80)	
Three types of	23.64	18.18	—	25.45	—	30.91	—	1·82	100%
diseases	6.02	8.55		9.86		8.54		(1.03)	(4.96%)
	(1.17)	(0.90)		(1.26)		(1.54)		(0.09)	
Four types of	34.29	22.86	—	17.14	—	25.71	—	—	100%
diseases	5.56	6.83		4.23		4.52			(3.15%)
	(1.08)	(0.72)		(0.54)		(0.82)			

Note : The numerator shows percentage of number of diseases, the denominator shows percentage in the tehil and the values in parentheses indicate percentage for the district

Table. 2. Water born diseases (in percent, based on 1107 sample villages

Type of water borne diseases	Nagaur	Jayal	Ladnu	Didwana	Nawa	Parbatsar	Degana	Merta	Total
Stomach	30.25	14.29	—	26.05	—	24.37	5.04	—	100%
disorders	12.37	8.99		16.40		9.12	7.89		(9.28%)
	(2.81)	(1.32)		(2.42)		(2.26)	(0.47)		
Deformation of	19.16	4.98	5.75	13.41	11.88	18.77	14.17	11.88	100%
bones	17.18	6.88	28.85	18.52	42.47	15.41	48.68	32.63	(20.35%)
	(3.90)	(1.01)	(1.17)	(2.73)	(2.42)	(3.82)	(2.88)	(2.42)	
Infectious	21.95	18.78	3.66	13.41	0.25	34.39	0.49	7.07	100%
diseases	30.93	40.74	28.85	29.10	1.37	44.34	2.63	30.53	(31.95%)
	(7.01)	(6.00)	(1.17)	(4.29)	(0.08)	(10.99)	(0.15)	(2.26)	
Guinea	23.33	16.63	4.46	13.79	8.32	20.08	6.29	7.10	100%
worm	39.52	43.39	42.30	35.98	56.16	31.13	40.80	36.84	(38.42%)
	(8.96)	(6.39)	(1.71)	(5.30)	(3.19)	(7.72)	(2.42)	(2.73)	

Note : The numcrator shows percentage of the disease in the district, the denominator shows percentage of the disease in the tehsil and the values in parentheses indicates total percentage

sumption, it is, probably, too low a value for application in the Indian arid zone. The reasons for this observation are: (a) the ICMR upper limit probably takes into account the intake of fluorides through tea, coffee, etc. as in western countries, and not as in the Indian arid zone, (b) the people of this tract generally depend on tank water and use well water only for 2-6 months in a year (Fig. 2), and (c) irrigation with groundwater is restricted in the region to a very small area and, as such, recycling of fluoride is not a matter of great concern here. It may be quite justifiable to raise the limit of 1.5 ppm fluoride in the groundwater to 2-3 ppm for the Indian arid zone. However, if need be, physiological investigations could be undertaken before relaxing this limit.

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